HIGH SCHOOL BOTANY.

In the Nebraska High School Manual, issued December, 1897, by the University of Nebraska, and the State Superintendent of Public Instruction, directions are given as to the teaching of Botany in the State High Schools, and especially those which are 'accredited' by the University. The substance of these directions may well receive the wider publicity which Science can give them.

"One year should be given to the study of plants in the high school. The old practice of beginning in the spring is no longer regarded as advisable by educators. The study may be made to alternate with some other subject, as Zoology or Physiology, or the alternate days may be used for laboratory work."

"Modern Botany requires a properly equipped laboratory. The room set apart for it must be well lighted, preferably from the north sky. It should be provided with firm tables 27 or 28 inches high, and there should be shelves and cases at the sides of the room. The microscopes must be from some good maker, so as to insure good results." Instruments by well known foreign and American makers are suggested, ranging in price from $16 to $20, and magnifying from 75 to 600 diameters. Dissecting sets and other necessary appliances are enumerated and their cost given.

"Some work may be done by the class, under the direction of the intelligent teacher, with but one microscope and the other appliances, but as soon as possible there should be in every high school six microscopes, each with its accompanying accessories. There should be, at the least, one-fifth as many microscopes as there are pupils in the class."

"*The Laboratory Work.*—In this year of work the pupil should study such selected plants as will give him a general outline of the Vegetable Kingdom, including a fair knowledge of the principal types of plants and the modifications they have undergone. For this purpose the following plants are recommended:

1. One or more protophytes, from the following list: *Chroococcus, Oscillaria, Nostoc, Bacillus.*

2. Several green seaweeds from the following: *Protococcus, Spirogyra, Vaucheria, Cladophora, Oedogonium,* and their degraded relatives *Mucor, Albugo, Peronospora,* etc.

3. At least one of the brown seaweeds: *Laminaria* or *Fucus.*

4. At least one of the red seaweeds: *Polysiphonia, Polcamium,* or *Corallina.*

5. Several sac-fungi, from the following lists: (*a*) *Erysiphe, Microsphaera, Podosphaera,* etc.; (*b*) *Plowrightia, Peziza;* (*c*) *Puccinia, Ustilago.*

6. Several higher fungi, from the following lists: (*a*) *Lycoperdon, Secotium, Ithyphallus;* (*b*) *Agaricus, Polyporus, Stereum.*

7. At least one of the mosses: *Mnium, Bryum, Timmia, Funaria* or *Hypnum.*

8. At least one of the fernworts: *Asplenium, Cystopteris, Pteris, Equisetum, Lycopodium* or *Selaginella.*

9. At least one of the gymnosperms: *Pinus, Larix, Abies* or *Picea.*

10. At least six angiosperms, as follows: (*a*) two monocotyledons, one of which has superior ovaries, as *Alisma, Trillium, Lilium, Erythronium,* etc.; the other with inferior ovaries, as *Iris, Amaryllis, Orchis, Spiranthes,* etc.; (*b*) four dicotyledons, one with superior ovaries and choripetalous corolla, as *Ranunculus, Capsella, Viola, Silene, Callirrhoë, Geranium, Potentilla, Fragaria, Astragalus,* etc.; another, with superior ovaries and gamopetalous corolla, as *Primula, Steironema, Phlox, Hydrophyllum, Lithospermum, Ipomoea, Physalis, Pentstemon, Mentha, Salvia,* etc.; a third, with inferior ovaries and choripetalous corolla, as *Epilobium, Oenothera, Mentzelia, Opuntia, Aralia, Cornus, Daucus, Pastinaca, Osmorrhiza,* etc.;

and a fourth, with inferior ovaries and gamopetalous corolla, as *Sambucus*, *Viburnum*, *Houstonia*, *Galium*, *Campanula*, *Vernonia*, *Aster*, *Helianthus*, etc.

In the foregoing work the pupil should get some idea of the structure of the whole plant. He should learn enough technical descriptive terms so that he can give intelligent descriptions of each plant. At every stage of the work the pupil should be required to make careful drawings in his note-book, accompanied by concise descriptions of essential characters."

Suggestions as to the proper selection of books for a small botanical library and the collection of a reference herbarium are given. Field work and the systematic determination of plants are encouraged, this work being regarded as a desirable part of the pupil's training, although it must not be permitted to occupy so large a portion of his time as was formerly the general custom.

It may interest botanists in colleges as well as in high schools to know that before these directions were issued a considerable number of the Nebraska high schools were already giving essentially the work outlined above, and there are many indications that encourage us to hope that it will not be long before this will be true of all.

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EXTRA-ORGANIC EVOLUTION.

IN explaining the method of evolution Darwin and Wallace have laid great stress upon the struggle between *organisms*, Roux upon the struggle between the *parts of the organism*, and Weismann upon the all-sufficiency of natural selection. Darwin emphasizes *organic selection*, Roux *intra-organic selection*, and Weismann *germinal selection*. All progress is thus apparently organic. Heredity, at least with Weismann, is the continuity of the germ plasm, and progress is due to the survival and accumulation of advantageous congenital variations *within* the organism.

I wish to speak of what I may call *extra-organic* evolution. Progress has marched with colossal strides during the last fifty and even twenty years. Nevertheless, we see no corresponding advances made organically which may be deemed adequate to such progress. As far as our congenital or blastogenic qualities are concerned, we are probably little if any better than our forefathers of fifty or a thousand years ago. The progress actually made is out of all proportion to the advances made in our organisms.

Our sense and motor organs are essentially instruments and tools. So also, for that matter, is the brain. They are sifters, sentinels, receivers, transmitters, etc., all pressed into the service of the organism or some of its parts. The eye is manifestly an optical instrument, though a poor one, when compared with that additional eye or sense organ, the microscope or telescope. It is a well-known fact that it suffers from every defect that can be found in an optical instrument. It was useful in its time, and is so, I presume, to-day. Civilization, however, has taken its gigantic strides guided by extra-organic eyes.

Most, if not all the three hundred or more mechanical movements known to mechanics to-day are found exemplified in the human body. From an evolutionary standpoint it is still more important to note that all the machinery in the world, all the bars, levers, joints, pulleys, pumps, girders, wheels, axles, ball-and-socket movements, etc., etc., are but variations, extensions, adaptations of the accumulated advantageous variations and adaptations of the human organism.

Thus our sense organs are indefinitely multiplied and extended by such extra-organic sense organs as the microscope, telescope, resonator, telephone, telegraph, thermometer, etc. Our motor organs are